

What is claimed is:

1. A method of making an ester comprising:
  - (a) contacting an olefin or ether with carbon monoxide and an acid
  - 5 composition comprising  $\text{BF}_3 \cdot 2\text{ROH}$  to form a product composition;
  - (b) adding  $\text{ROH}$  to the product composition of (a); and
  - (c) separating an acid product comprising  $\text{BF}_3 \cdot 2\text{ROH}$  from the ester.
2. The method of claim 1 further comprising:
  - 10 (d) recycling a portion of the separated acid product to contact the olefin or ether.
3. The method of claim 1 wherein the olefin is selected from the group consisting of ethylene, propylene, isoolefins, normal butenes, and  $\text{C}_5$  to  $\text{C}_{18}$  olefins.
- 15 4. The method of claim 2 wherein the olefin is isobutene.
5. The method of claim 1 wherein the ether is represented by the general formula  $\text{R}'-\text{O}-\text{R}''$ , wherein  $\text{R}'$  = saturated  $\text{C}_1$  -  $\text{C}_{13}$  alkyl and  $\text{R}''$  = saturated  $\text{C}_1$  -  $\text{C}_{13}$  alkyl, and  $\text{R}'$  and  $\text{R}''$  can be the same or different.
- 20 6. The method of claim 5 wherein the ether is methyl-t-butylether.
7. The method of claim 1 wherein contacting the olefin or ether
- 25 comprises contacting at a temperature from about  $60^\circ\text{C}$  to about  $200^\circ\text{C}$ .
8. The method of claim 7 wherein contacting the olefin or ether comprises contacting at a temperature from about  $110^\circ\text{C}$  to about  $160^\circ\text{C}$ .
- 30 9. The method of claim 1 wherein contacting the olefin or ether comprises contacting at a pressure from about 30 atm to about 200 atm.
10. The method of claim 9 wherein contacting the olefin or ether comprises contacting at a pressure from about 110 atm to about 160 atm.

11. The method of claim 1 wherein ROH is an alcohol selected from the group consisting of methanol, n-propanol, n-butanol, 2-propanol, 2-ethyl hexanol, isohexanol, isoheptanol, isoctanol, isononanol, 3,5,5-trimethyl hexanol, isodecanol, 5 isotridecanol, 1-octanol, 1-decanol, 1-dodecanol, and 1-tetradecanol.

12. The method of claim 1 wherein ROH is methanol.

10 13. The method of claim 1 wherein the ether is methyl-t-butyl ether.

14. The method of claim 1 wherein the ether is diisopropyl ether and ROH is 2-propanol.

15 15. The method of claim 1 further comprising:

(d) contacting the olefin or ether with a hydrocarbon, wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

20 16. The method of claim 1 further comprising:

(d) adding a hydrocarbon to the product composition of (a), wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

25 17. The method of claim 16 further comprising:

(e) separating the hydrocarbon and ROH from  $\text{BF}_3 \cdot 2\text{ROH}$  and directing a portion of the separated hydrocarbon and the separated ROH to a unit selected from the group consisting of a separation unit, a reaction unit, and a combination thereof.

30 18. The method of claim 1 further comprising:

(d) contacting the olefin or ether with phosphoric acid.

19. The method of claim 1 wherein separating the acid product comprises concentrating the acid product such that the molar ratio ROH:BF<sub>3</sub> in the concentrated acid product is from about 2:1 to about 4:1.

5 20. The method of claim 19 wherein the concentrated acid product comprises a molar ratio of ROH:BF<sub>3</sub> from about 2:1 to about 3:1.

10 21. The method of claim 1 wherein the acid composition comprises a molar ratio of ROH:BF<sub>3</sub> from about 1.6:1 to about 3: 1.

22. The method of claim 21 wherein the acid composition comprises a molar ratio of ROH:BF<sub>3</sub> from about 1.9:1 to about 3: 1.

15 23. The method of claim 1 where the product composition contains less than 3% by weight carboxylic acid.

20 24. A method of making methyl pivalate comprising:  
contacting methyl-t-butylether with carbon monoxide and an acid composition comprising BF<sub>3</sub>·2CH<sub>3</sub>OH to form a product composition comprising methyl pivalate;  
adding methanol to the product composition; and  
separating an acid product comprising BF<sub>3</sub>·2CH<sub>3</sub>OH from the methyl pivalate.

25 25. The method of claim 24 wherein contacting methyl-t-butylether comprises contacting at a temperature of about 110°C to about 160°C.

26. The method of claim 24 wherein contacting methyl-t-butylether comprises contacting at a pressure from about 30 atm to about 200 atm.

30 27. The method of claim 24 further comprising contacting the methyl-t-butylether with a hydrocarbon, wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

28. The method of claim 24 further comprising contacting the product composition with a hydrocarbon, wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

5 29. The method of claim 28 further comprising separating the hydrocarbon and the methanol from the methyl pivalate and directing a portion of the separated hydrocarbon and the separated methanol to a unit selected from the group consisting of a separation unit, a reaction unit, and a combination thereof.

10 30. The method of claim 24 further comprising contacting the methyl-t-butylether with phosphoric acid.

15 31. The method of claim 24 wherein separating the acid product comprises concentrating the acid product such that the molar ratio ROH:BF<sub>3</sub> in the acid product is from about 2:1 to about 4:1.

32. The method of claim 31 wherein the concentrated acid product comprises a molar ratio of ROH:BF<sub>3</sub> from about 2:1 to about 3:1.

20 33. The method of claim 24 wherein the acid composition comprises a molar ratio of ROH:BF<sub>3</sub> from about 1.6:1 to about 3: 1.

34. The method of claim 33 wherein the acid composition comprises a molar ratio of ROH:BF<sub>3</sub> from about 1.9:1 to about 3: 1.

25 35. The method of claim 24 wherein the product composition contains nonanoic methyl esters such that the molar ratio of methyl pivalate to nonanoic methyl esters is about 4 or greater.